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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/673,908	09/30/2003	Hideaki Yamasaki	071469-0305913	7362

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EXAMINER	
GEYER, SCOTT B	

ART UNIT	PAPER NUMBER
2812	

DATE MAILED: 02/16/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/673,908	YAMASAKI ET AL.	
	Examiner	Art Unit	
	Scott B. Geyer	2829	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *01 October 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-49* is/are pending in the application.

4a) Of the above claim(s) *35-49* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-34* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *30 September 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *0204*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

1. Applicant's election with traverse of claims 1-34 (encompassing group I) in the reply filed on October 1, 2004 is acknowledged. The traversal is on the ground(s) that the subject matter of groups I and II are sufficiently related and that no serious burden exists to search both groups. This is not found persuasive because the examiner has clearly shown that the two groups of claims are in two different classes. Further, searching two different classes is considered a serious burden upon the examiner. Also, the examiner does not believe that proper restriction between the two groups would result in a duplicative search, since the claims have been grouped into two different classes of subject matter. The requirement is still deemed proper and is therefore made FINAL.

Information Disclosure Statement

2. The references cited within the IDS document filed February 13, 2004 (paper no. 0204) have been considered.

Drawings

3. The drawings filed by the applicant on September 30, 2003 are acceptable.

Claim Rejections - 35 USC § 112

4. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

5A. Claims 11, 13, 14, 17, 27, 29, 30 and 33 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. As to the above mentioned claims, the applicant recites a "dilution gas" which is separate from a "carrier gas". However, as noted in claims 14 and 30, either of the dilution gas or the carrier gas can be the same gaseous materials. For example, for claim 14, the claim can be interpreted as "either the carrier gas is argon or the dilution gas is argon". Since the claim limitations allow for the same gas to be called a "carrier gas" or a "dilution gas", it is unclear to the examiner as to what the applicant intends the difference between "carrier gas" and "dilution gas" to be. Since, for example, elemental Argon gas can be used as either a carrier gas or as a dilution gas for the applicant's claims, it is to be interpreted by the examiner that there is no difference between the term "dilution gas" and "carrier gas". (*For purposes of analogy only, the examiner views this as similar to the difference between the term "semiconductor chip" and "semiconductor die".*)

5B. Claim 31 recites the limitation "the showerhead" in line 3. There is insufficient antecedent basis for this limitation in the claim. Applicant should change "the" to - - a - - to overcome this rejection (see similar claim 15).

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

7. Claims 1-14, 16-30 and 32-34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Goldman et al. (4,619,840) in view of Wang et al. (6,833,161 B2).

7A. As to **claim 1**, Goldman et al. teach a method of depositing a metal layer on a substrate. Specifically, Goldman et al. teach providing a substrate in a process chamber (column 2, lines 34-39) and introducing a process gas into the chamber (column 2, lines 47-50). Goldman et al. teach an area above the wafer within the process chamber (i.e. creating a "processing zone"), as can be seen in figure 3. Goldman et al. teach depositing a metal layer on the substrate by thermal chemical vapor deposition (column 2, lines 47-51).

Goldman et al. do not teach a residence time (i.e. *time that the gaseous species is above the substrate that is being deposited upon, before exiting the chamber*) for the gaseous species in the processing zone (i.e. within the process chamber above the wafer), having a time shorter than about 120 msec (0.12 seconds).

However, Wang et al. teach a similar method of depositing a metal onto a substrate using CVD. A tungsten-compound gas is introduced into the chamber (column 6, lines 1-27). Specifically, it is "pulsed for about 1 second or less, such as about .2 seconds or less" (i.e. *a range from about 1 second to about 0 seconds*) (column 6, lines 19-20).

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to modify the method of Goldman et al. with a residence time

shorter than about 0.12 seconds as taught by Wang et al. so as to control the thickness of the metal layer being deposited and not allow excess build-up within the processing chamber.

7B. As to **claims 2 and 3**, Wang et al. teach a tungsten-compound gas is introduced into the chamber (column 6, lines 1-27). Specifically, it is "pulsed for about 1 second or less, such as about .2 seconds or less" (i.e. *a range from about 1 second to about 0 seconds*) (column 6, lines 19-20). The range of about 1 second to about 0 seconds covers a residence time limitation of shorter than 70 msec of claim 2 and shorter than 40 msec in claim 3.

7C. As to **claim 4**, Goldman et al. teach a pressure of the processing chamber from about 150 mTorr to about 3 or 4 Torr (column 8, lines 19-21).

7D. As to **claim 5**, Goldman et al. teach a pressure of the processing chamber being as low as "approximately 100 millitorr" (column 8, lines 56-59).

7E. As to **claim 6**, Wang et al. teach metal-containing compound introduced at a rate of about 1 sccm to about 400 sccm (column 6, lines 15-17). More specifically, the metal-compound ins a tungsten-compound (column 6, line 15) and more specifically, the tungsten-compound is a tungsten carbonyl compound (column 8, line 21).

7F. As to **claims 7 and 8**, Goldman et al. teach the substrate (i.e., wafer) heated to about 400°C (column 2, lines 39-41).

7G. As to **claim 9**, Goldman et al. teach the metal-carbonyl precursor gas to be $W(CO)_6$ (column 2, line 46).

7H. As to **claim 10**, Goldman et al. teach depositing tungsten on the wafer (column 2, lines 50-51).

7I. As to **claims 11-14**, Wang et al. teach a carrier gas/dilution gas, such as argon, hydrogen or helium, having a flow rate between about 250 sccm and 1000 sccm (column 5, lines 58 et seq.). (see paragraph **5A** above).

7J. As to **claim 16**, Goldman et al. teach introducing tungsten carbonyl to the reaction chamber, wherein carbon monoxide gas (a reaction-by-product) is produced while tungsten is deposited onto the wafer (column 2, lines 47-51).

7K. As to **claim 17**, Wang et al. teach a carrier gas/dilution gas used to carry the tungsten carbonyl into the reaction chamber (column 5, lines 58 et seq.).

7L. As to **claim 18**, Goldman et al. teach the substrate being a silicon wafer (i.e. a semiconductor substrate) (column 2, lines 37-41).

7M. As to **claim 19**, Goldman et al. teach a method of depositing a tungsten layer on a substrate. Specifically, Goldman et al. teach providing a substrate in a process chamber (column 2, lines 34-39) and introducing a tungsten carbonyl process gas into the chamber (column 2, lines 47-50). Goldman et al. teach an area above the wafer within the process chamber (i.e. creating a "processing zone"), as can be seen in figure 3. Goldman et al. teach depositing a tungsten layer on the substrate by thermal chemical vapor deposition (column 2, lines 47-51).

Goldman et al. do not teach a residence time (i.e. *time that the gaseous species is above the substrate that is being deposited upon, before exiting the chamber*) for the

gaseous species in the processing zone (i.e. within the process chamber above the wafer), having a time shorter than about 120 msec (0.12 seconds).

However, Wang et al. teach a similar method of depositing a metal onto a substrate using CVD. A tungsten-compound gas is introduced into the chamber (column 6, lines 1-27). Specifically, it is "pulsed for about 1 second or less, such as about .2 seconds or less" (i.e. *a range from about 1 second to about 0 seconds*) (column 6, lines 19-20).

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to modify the method of Goldman et al. with a residence time shorter than about 0.12 seconds as taught by Wang et al. so as to control the thickness of the metal layer being deposited and not allow excess build-up within the processing chamber.

7N. As to **claims 20 and 21**, Wang et al. teach a tungsten-compound gas is introduced into the chamber (column 6, lines 1-27). Specifically, it is "pulsed for about 1 second or less, such as about .2 seconds or less" (i.e. *a range from about 1 second to about 0 seconds*) (column 6, lines 19-20). The range of about 1 second to about 0 seconds covers a residence time limitation of shorter than 70 msec of claim 2 and shorter than 40 msec in claim 3.

7O. As to **claim 22**, Goldman et al. teach a pressure of the processing chamber from about 150 mTorr to about 3 or 4 Torr (column 8, lines 19-21).

7P. As to **claim 23**, Goldman et al. teach a pressure of the processing chamber being as low as "approximately 100 millitorr" (column 8, lines 56-59).

7Q. As to **claim 24**, Wang et al. teach metal-containing compound introduced at a rate of about 1 sccm to about 400 sccm (column 6, lines 15-17). More specifically, the metal-compound ins a tungsten-compound (column 6, line 15) and more specifically, the tungsten-compound is a tungsten carbonyl compound (column 8, line 21).

7R. As to **claims 25 and 26**, Goldman et al. teach the substrate (i.e., wafer) heated to about 400°C (column 2, lines 39-41).

7S. As to **claims 27-30**, Wang et al. teach a carrier gas/dilution gas, such as argon, hydrogen or helium, having a flow rate between about 250 sccm and 1000 sccm (column 5, lines 58 et seq.). (see paragraph **5A** above).

7T. As to **claim 32**, Goldman et al. teach introducing tungsten carbonyl to the reaction chamber, wherein carbon monoxide gas (a reaction-by-product) is produced while tungsten is deposited onto the wafer (column 2, lines 47-51).

7U. As to **claim 33**, Wang et al. teach a carrier gas/dilution gas used to carry the tungsten carbonyl into the reaction chamber (column 5, lines 58 et seq.).

7V. As to **claim 34**, Goldman et al. teach the substrate being a silicon wafer (i.e. a semiconductor substrate) (column 2, lines 37-41).

/

8. Claims 15 and 31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Goldman et al. (4,619,840) and Wang et al. (6,833,161 B2) as applied to claims 1 and 19 above (respectively), and further in view of Kalyanam (6,491,978 B1).

8A. As to **claim 15**, Goldman et al. and Wang et al. teach all the limitations of claim 15, as noted above for claim 1. Goldman et al. also teach a processing area

volume, which is clearly defined between a "deposition chamber fitting 104" and the "silicon wafer 40", as seen in figure 3. Neither Goldman et al. nor Wang et al. specifically teach a showerhead. However, Kalyanam teach a CVD process apparatus as shown in figure 4, which has a "dual manifold distributor, or showerhead 440". It would have been obvious to a person of ordinary skill in the art at the time the invention was made to modify the method of Goldman et al. and Wang et al. with a showerhead apparatus within the CVD process chamber as taught by Kalyanam so as to allow for uniform application of the gaseous state precursor gas over the substrate.

8B. As to **claim 31**, Goldman et al. and Wang et al. teach all the limitations of claim 31, as noted above for claim 19. Goldman et al. also teach a processing area volume, which is clearly defined between a "deposition chamber fitting 104" and the "silicon wafer 40", as seen in figure 3. Neither Goldman et al. nor Wang et al. specifically teach a showerhead. However, Kalyanam teach a CVD process apparatus as shown in figure 4, which has a "dual manifold distributor, or showerhead 440". It would have been obvious to a person of ordinary skill in the art at the time the invention was made to modify the method of Goldman et al. and Wang et al. with a showerhead apparatus within the CVD process chamber as taught by Kalyanam so as to allow for uniform application of the gaseous state precursor gas over the substrate.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Scott B. Geyer whose telephone number is (571) 272-1958. The examiner can normally be reached on weekdays, between 10:00am - 6:30pm. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Lebentritt can be reached on (571) 272-1873. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306. Information regarding the status of an application may be obtained from

the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

SCOTT GEYER
PATENT EXAMINER

SBG
February 10, 2005

2/10/05